

# RESIDENTIAL RAINWATER HARVESTING PROJECT

*ALTITUDE ENGINEERING, INC.*

PRESENTERS: HAYLIE BREWER, ERICA KIESOW, & BRETT HIGHTOWER

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# PROJECT PURPOSE

2

- ▶ Design and implement a rainwater harvesting catchment system
- ▶ Use storm water to irrigate client's vegetable garden, and supply toilet flushing water
  - ▶ Reduce water utility cost
  - ▶ Minimize potable water usage

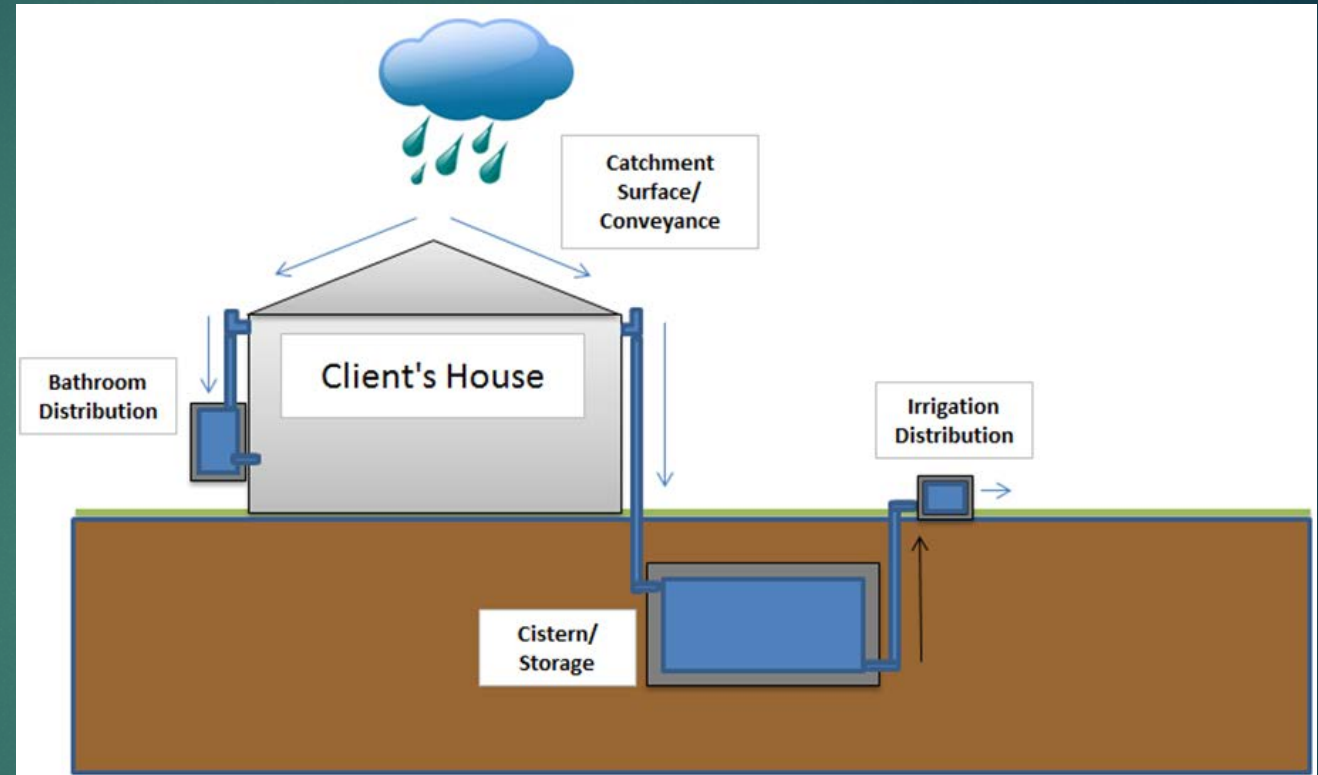


Figure 1: Rainwater Harvesting Schematic

# PROJECT BACKGROUND

- ▶ Client: Professor Alarick Reiboldt, EIT, MENG, Lecturer
- ▶ Located in Kachina Village



*Figure 2: Residential Project Site*



*Figure 3: Existing Garden Site*

# TECHNICAL CONSIDERATIONS

## ▶ *Cistern Design*

- ▶ Primary Storage for distribution system
- ▶ Construction materials will be constrained by budget
- ▶ Size of cistern will depend on the demand for both the irrigation and toilet use
- ▶ Cistern Stability/Load-Bearing Capacity

## ▶ *Pump Selection Specifications*

- ▶ Required power, flow, pressure head

## ▶ *Determination and Delineation of Catchment Surface*

- ▶ Slope and area of roof
- ▶ Runoff precipitation route

## ▶ *Irrigation Distribution Analysis*

- ▶ Gravitational vs. Pressurized

## ▶ *Geotechnical Aspects*

- ▶ Drainage behavior
- ▶ Influence of water on the proposed cistern

# STAKEHOLDERS

## ▶ *Client, ALARICK REIBOLDT*

- ▶ End user of the rainwater harvesting system
- ▶ Using final design to irrigate vegetable garden and will provide a bathroom water source
- ▶ Criteria for the design is specified by the client

## ▶ *Coconino County Community*

- ▶ Municipality as a whole can be affected by the rainwater harvesting process
- ▶ The rainwater collected will not be able to recharge the Coconino aquifer

## ▶ *ALTITUDE ENGINEERING, INC. PROJECT STAFF*

- ▶ Responsible for delivering a completed design
- ▶ Reputations as future Engineers

# SCOPE OF SERVICES

## ▶ *Task 1.0 Field Evaluation*

- ▶ Task 1.1 Site Evaluation: General Inspection
- ▶ Task 1.2 Site Evaluation: Structural

## ▶ *Task 2.0 Design Standards, Specifications, and Codes*

- ▶ Task 2.1 Design specifications for freeze prevention for water utilities
- ▶ Task 2.2 Harvesting limitations

## ▶ *Task 3.0 Design: Catchment System*

- ▶ Task 3.1 Roof Runoff
- ▶ Task 3.2 Gutter Collection System Design
- ▶ Task 3.3 Conveyance System Design
- ▶ Task 3.4 First Flush/Disinfection System Design

## ▶ *Task 4.0 Cistern*

- ▶ Task 4.1 Capacity
- ▶ Task 4.2 Location
- ▶ Task 4.3 Construction Materials Specifications
- ▶ Task 4.4 Disinfection
- ▶ Task 4.5 Concrete Slab Design

# SCOPE OF SERVICES, CONTINUED

## ▶ *Task 5.0 Design: Bathroom Distribution*

- ▶ Task 5.1 Distribution Design
- ▶ Task 5.2 Pump Selection and Specification
- ▶ Task 5.3 Storage Tank
- ▶ Task 5.4 Construction Material

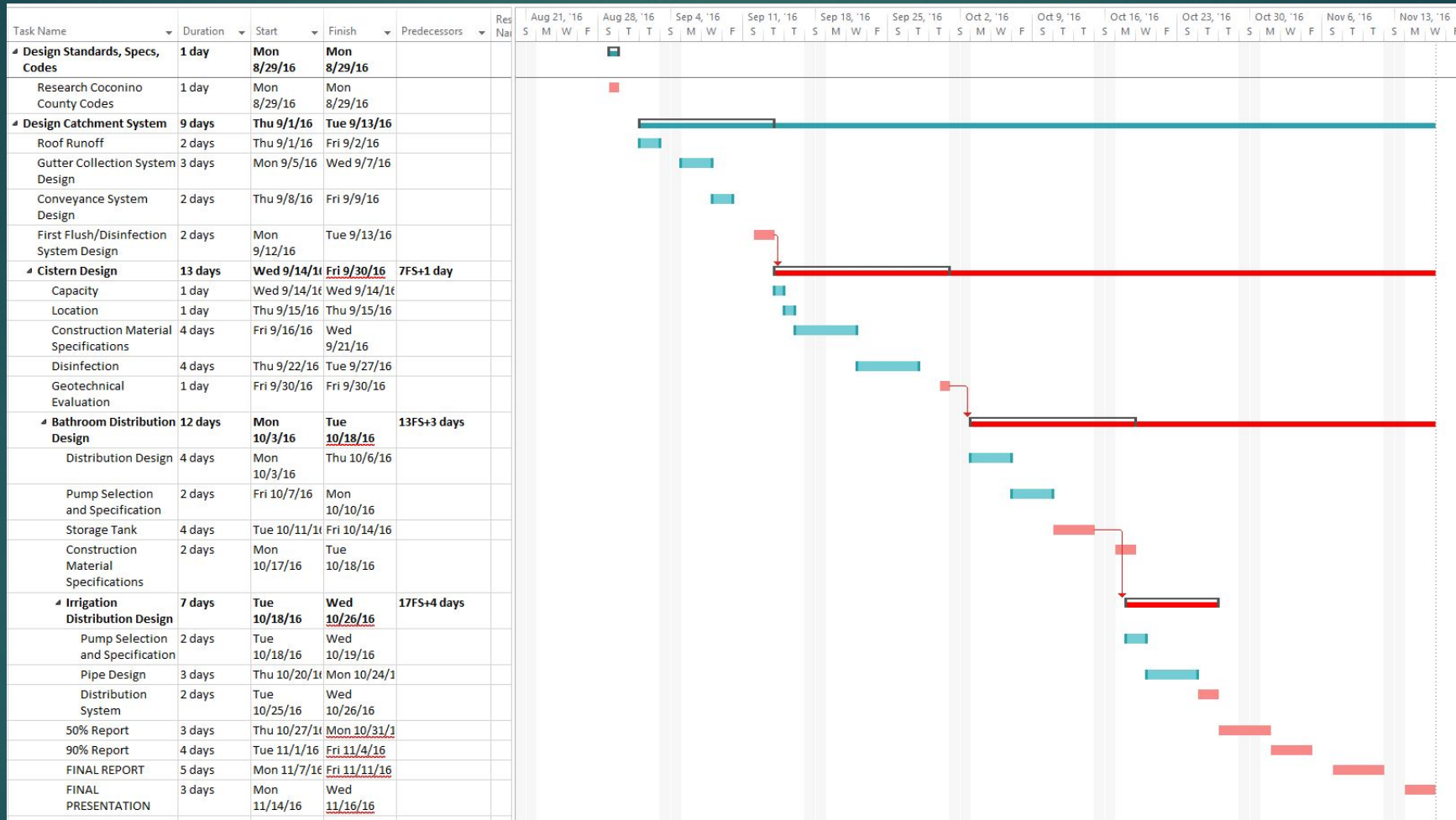
## ▶ *Task 6.0 Design: Irrigation Distribution*

- ▶ Task 6.1 Pipe Design
- ▶ Task 6.2 Pump Selection and Specification
- ▶ Task 6.3 Distribution System

## ▶ *Task 7.0 Project Management*

- ▶ Task 7.1 Client, Technical Advisor and Team Meetings
- ▶ Task 7.2 50% Report
- ▶ Task 7.3 90% Report
- ▶ Task 7.4 Final Proposal
- ▶ Task 7.5 Final Presentation
- ▶ Task 7.6 Website

# SCHEDULE: GANTT CHART





# STAFFING AND COST

*Table 1: Staff Classification and Code*

Classification	Code
Senior Engineer	SENG
Engineer II	ENG II
Engineer I	ENG I
Geotechnical Technician	GTECH
Administrative Assistant	AA

*Table 2: Projected Design Costs*

Classification	Hours	Billing Rate, \$/hr	Cost, \$
SENG	13	\$ 170.00	\$ 2,210.00
ENG II	117	\$ 100.00	\$ 11,700.00
ENG I	265	\$ 65.00	\$ 17,225.00
GTECH	13	\$ 22.00	\$ 286.00
AA	45	\$ 30.00	\$ 1,350.00
<b>TOTAL</b>			<b>\$32,771.00</b>

# STAFFING AND COST, CONTINUED

<b>1.0 Field Evaluation</b>	<b>1.1 Site Inspection</b>		2	8		
<b>2.0 Design Standards, Specs, Codes</b>	Research Coconino County Codes		3	16		
<b>3.0 Design Catchment System</b>	Roof Runoff		1	6		
	Gutter Collection System Design		8	12		
	Conveyance System Design		8	10		
	First Flush/Disinfection System Design		7	15		
<b>4.0 Cistern Design</b>	Capacity		3	10		
	Location		3	6		
	Construction Material Specifications		8	10		
	Disinfection		4	12		
	Geotechnical Evaluation				8	
	Slab Design		10	30		

<b>5.0 Bathroom Distribution Design</b>	<b>Distribution Design</b>		10	20		
	Pump Selection and Specification		2	6		
	Storage Tank		10	20		
	Construction Material Specifications		4	8		
<b>6.0 Irrigation Distribution Design</b>	Pump Selection and Specification		2	6		
	Pipe Design		8	10		
	Distribution System		2	4		
<b>7.0 Project Management</b>	7.1 Meetings	5	10	20	3	5
	7.2 50% Report	2	4	15	2	10
	7.3 90% Report	2	4	15		10
	7.4 Final Proposal	2	4	3		5
	7.5 Final Presentation	2	2	3		
	7.6 Website					15
	Subtotal	13	117	265	13	45
	<b>Total</b>			453		

# QUESTIONS?

*Special thanks to Dr. Jeffrey Heiderscheidt and Professor Alarick Reiboldt for their time, insight and efforts in guiding team Altitude Engineering's CENE476 project towards success.*